HOW TO TEACH MATHEMATICS WITH MOODLE

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Abstract

The aim of this article is to present a Project in the Oporto's Institute of Accounting and Administration, which pretends to contribute for a change in the way of teaching and learning Mathematics.
One of the main objectives of this project is to innovate the teaching and learning processes, exploring technologies as a pedagogical resource and to induce higher motivation to students, improve the rate of success and make available to students a set of materials adapted to their needs. This concern is justified due to the fact that students have a weak preparation, without consolidated basis.
Since the year 2007/2008 the courses were adjusted to the Bologna process, which requires several changes in teacher's and student's roles, methodologies and assessment.
The number of weekly classes has been reduced, so it was necessary to develop new strategies and methodologies to support the student. With the implementation of the Bologna Process in the Accounting degree, we felt a great need to provide other types of activities to students.
To complement our theoretical and practical classes we have developed a project called *MatActiva* based on the *Moodle* platform offered by PAOL - *Projecto de Apoio On-Line* (Online Support Project).
Moodle allows us to use the language T_EX to create materials that use mathematical symbols. Using this functionality, we created a set of easy to use interactive resources.
In *MatActiva* project, the students have access to a variety of different materials. We have followed a strategy that makes the project compatible with the theoretical and practical subjects/classes, complementing them. To do so, we created some resources, for instance multiple-choice tests, which are the most accessed by the students. These tests can be realized and corrected on-line and for each wrong answer there is a feedback with the resolution. We can find other types of resources: diagnostic tests, theoretical notes. There are not only the pre-requirements for subjects mathematics, but also materials to help students follow up the programs. We also developed several lessons. This activity consists of a number of pages, where each page has contents and leads to other pages, based on the student's progress. The teacher creates the choices and determines the next page that the student will see, based upon their knowledge. There is also an area of doubts, where the students can place all the mathematical doubts they have, and a teacher gives the answers or clues to help them in their work. MatActiva also offers an area where we can find some humour, curiosities, contests and games including mathematical contents to test the math skills, as well as links to pages about mathematical contents that could be useful for the study.
Since ISCAP receives ERASMUS students and some of them attend mathematics, we developed some materials in English, so they can also use MatActiva.
The main objectives of our project are not only to bring success in the subjects of mathematics, but also to motivate the students, encourage them to overcome theirs difficulties through an auto-study giving them more confidence and improve their relationship with the mathematics as well as the communication between students and teachers and among students.

Keywords
Mathematics, Moodle, projects and innovations, research in education, technology in education.

1. INTRODUCTION

Almost all mathematicians teach mathematics, but when they are asked the pedagogical question of how mathematics should be taught, their answers reveal many different viewpoints. Some lecture, give students traditional assignments, drill their students, and want students to take the initiative in the learning process. Others favour discovery, cooperative learning, use of technology, higher-order thinking skills, and downplay memorization and drill. We, along with some lessons more expositive, encourage the use of new technologies and try to take advantage of them as tools to support the teaching and learning process.

The Institute of Accounting and Administration of Oporto (ISCAP) belongs to one of Portugal's largest and most prestigious public Polytechnic Institutes, the Polytechnic Institute of Oporto (IPP). ISCAP has 238 teachers and it offers its 4,000-strong student population a range of innovative graduate programs in Accounting and Administration, International Commerce, Marketing, Business Communication, and Administrative Assistance and Translation. The Accounting course is the one that has a larger number of students.

Several public and private schools in the region also offer some of these courses. One of the means of ISCAP to compete with these schools and impose itself in the higher Portuguese education, is offering a captivating education, adapted to the needs of students and to the new challenges related in the Bologna Process.

In order to answer to new challenges, the ISCAP started in 2003 the Online Support Project (PAOL) offering pedagogical and technical support to all teachers and students to make possible supplementary means for the presential subjects/classes, allowing the student greater facility of access to the materials for study and the communication activities of student-teacher and student-student.

In the beginning the e-learning platform used was WebCT but in 2005 it was changed to the platform Moodle (Modular Object-Oriented Dynamic Learning Environment). Moodle is an Open Source course management system centered around learners' needs and designed to support collaborative approaches to teaching and learning. Philosophically based on social constructionist pedagogy, Moodle has been and continues to be developed on a grassroots level, with new versions regularly released to the user community. Moodle offers users a rich interface, context-specific help buttons, and a wide variety of tools such as discussion forums, wikis, chat, surveys, quizzes, glossaries, journals, grade books and more, that allow them to learn and collaborate in a truly interactive space.

The number of PAOL users has been growing quite well as the number of areas involved and the type of activities that are offered became more complex. In part this is because the teachers have more knowledge about the platform, largely due to the training that has been provided by the PAOL, but also to their research and personal dedication.

In May 2006, 60% of the students and 30% of the teachers used the PAOL. Until then we could check that the scientific area of Mathematics was used the PAOL almost exclusively as a repository of information, where teachers put theoretical materials and exercises sheets as support of practical subjects/classes. The forums, chats or other activities were almost non-existent.

On the other hand, we all know that Mathematics is an essential component of the educational system. The teaching and learning of mathematics at the tertiary level is a matter of concern in almost all countries. Universities and Polytechnic Institutes face increasing difficulties at enrolling students in university studies in which mathematics is a substantial component and teachers face increasing difficulties at helping their students learn the mathematics they would like them to learn. It was thinking in overcoming these difficulties that we in 2006/2007 developed a project called *Matemática Activa no ISCAP* (*Active Mathematics in ISCAP*) based on the Moodle platform. So MatActiva arose as a need to improve learning and levels of success in the subjects of the area of Mathematics.

2. OBJECTIVES

The use of the new technologies it is recommended by several organizations (European Parliament and of the Council, The European ODL Liaison Committee, between others), because the information and communication technologies (ICT) offer significant potential for the improvement of education and training. They support learning processes, through enhanced communication, discovery, simulation, exploration and problem solving.

Answering these recommendations we created this new project to take advantage in Mathematics teaching.

The main objective of this project was to innovate the teaching and learning process exploring technologies as a pedagogical resource and to induce bigger motivation to the students, improve the rate of success rates and make available to students a set of materials adapted to their needs. This concern is justified due to the fact that students have a weak preparation without consolidated basis.
One of the great objectives is to motivate students, encourage them to overcome their difficulties through a self-study giving them more confidence.
The pedagogical innovation and flexibility temporal supporting the individual and collaborative study of students, has been of great importance especially for the working students who can not always attend classes and timely access to the support materials. The aim is not to replace the classroom presence but a complement to these.
The specific objectives underlying the elaboration of this project were to create a secure repository for documents, providing support material, promote self-learning, increase the self-confidence of students, increase the communication between students and teachers and between students.

3. THE LEARNING AND TEACHING PROCESS

Several studies point to the need to develop teaching strategies that address the various styles of learning (Skalnik et al. In Gunkel (1996) - as quoted by Reid (1996)). There is a need to create curriculum materials that increase the confidence of students, making them responsible for their own education and learning. In this model, teachers act as facilitators, guiding the students instead of imposing subjects. In particular, in our school we give a special emphasis to the connection of mathematics with economics.
The perspective values and aims of our students have changed. We as mathematics educators working at tertiary level, need to destroy some myths, practices and considerations by taking some positive steps towards another way of teaching. There are some changes to be considered and some goals for our future as mathematics teachers, it is time for us to make some crucial changes in mathematics education. So it's time for action.
The new paradigm is based on a model that requires new skills and new teaching practices. The teachers must develop methodologies more dynamic and centralized in the student. Meanwhile to the student is require a greater involvement in the choice of his school journey, greater responsibility and commitment in the teaching / learning process. That's why changes are needed at the level of the objectives and methods of teaching / learning and even the evaluation.
This year, with the implementation of the Bologna Process in the Accounting course, we feel a great need to provide other types of activities to students. The time for theoretical and practical subjects/classes has been reduced, so it was necessary to modify the way of teaching and learning. In the theoretical and practical classes we follow the programme with elucidative examples through PowerPoint slides.
On the page of the subject in PAOL, students have the slides and exercises for subjects/classes, as well as sheets of supplementary exercises. All these resources are available in pdf format, in general, a week before being taught in class.
We have followed a strategy that makes the project compatible with the theoretical and practical subjects/classes, complementing them. So on the page of the MatActiva we can find other types of resources: diagnostic tests, multiple-choice tests, an area of doubt, an area of humour and links to pages about mathematics.
We would like to bring back with MatActiva the spirit that is necessary to defend the need of producing good teaching materials.
To build this project we took into consideration what technology can and must do in mathematics instruction and for that we follow the John Keller's [5] ARCS model, that defends proper instruction must implement:

- Attention - the instruction must capture students' attention.
- Relevance - the student must find the materials relevant to him or her.
- Confidence - the instruction must develop students' confidence in their own capabilities.
- Satisfaction - in the end of the educational event, the student must get satisfaction from knowing that he or she has mastered the required content.

Now we will describe how the project MatActiva has been implemented in The Institute of Accounting and Administration of Oporto (ISCAP).

4. ORGANIZATION AND IMPLEMENTATION

A small group of mathematics teachers, of which we are part, developed the project MatActiva and since then have worked with the sole motivation of improving the mathematical knowledge of our students and the relationship they have with mathematics.
The organization and implementation followed by an approach by chapters of the subjects treated in the classes.
We have been concerned in creating a project of simple access, intuitive and with a set of useful functionalities according to the subjects taught in mathematics.
In figure 1 we can observe the initial menu with 6 topics.

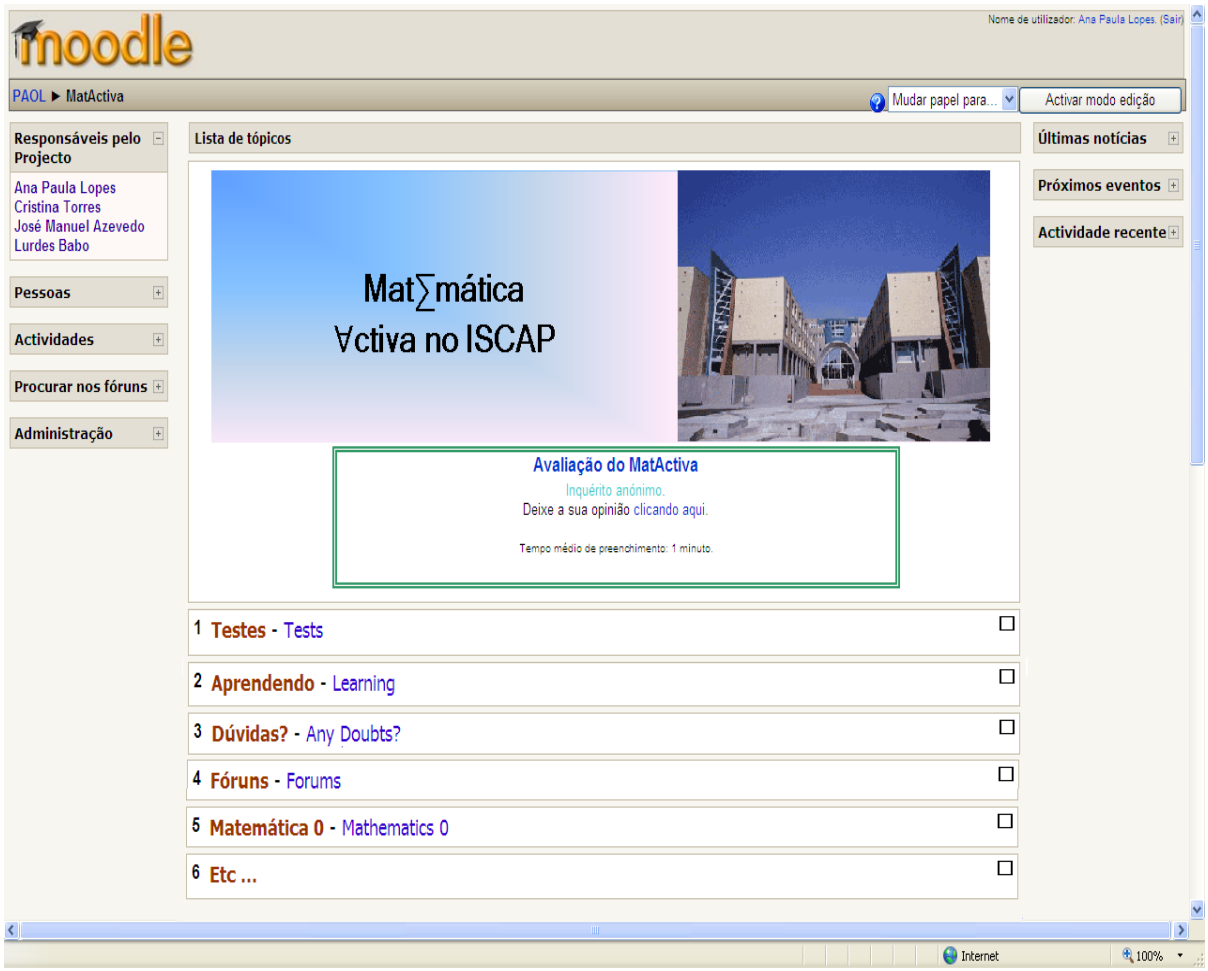

Fig.1. Initial menu

- Tests – At this point the students can find and solve online diagnostic tests, evaluation tests with multiple choice or true / false questions. We have created a large bank of questions that originated a series of self-evaluation tests, which the student can solve and submit, taking conscience of their level of knowledge.

- Learning – In this topic students can find guide lessons about subjects related with the program of mathematics and find great math formulas resources and math tables, as well as links to pages about mathematical contents that could be useful for the study.

- Any Doubts? – Here the students can put their doubts online and there is a teacher that gives online answers.

- Forums - Leave Your Opinion – where the students can leave their opinions about MatActiva and give suggestions to improve the project.

- Mathematics Zero – An area that serves as support for the students who have difficulties and deficiencies in basic mathematics. The students that are in the Mathematics Zero have access to support documents to the subjects/classes of this course.

- Etc… – We can find here some humour, curiosities, contests and games including mathematical contents to test the math skills, so that students can relax a little and enjoy mathematics and see how mathematics are amazing.

It was to the topic tests that we dedicated more time, since this topic is one of greatest help in the preparation of the students for tests of the subjects of Mathematics in the first year of the Accounting course.
To build our tests we started to create a large set of questions and put them in a data base, organized by categories. This is important because it facilitates the search of a question when we are doing a test and also because we do tests in random form.
We can see some categories created by us, in the next figure.

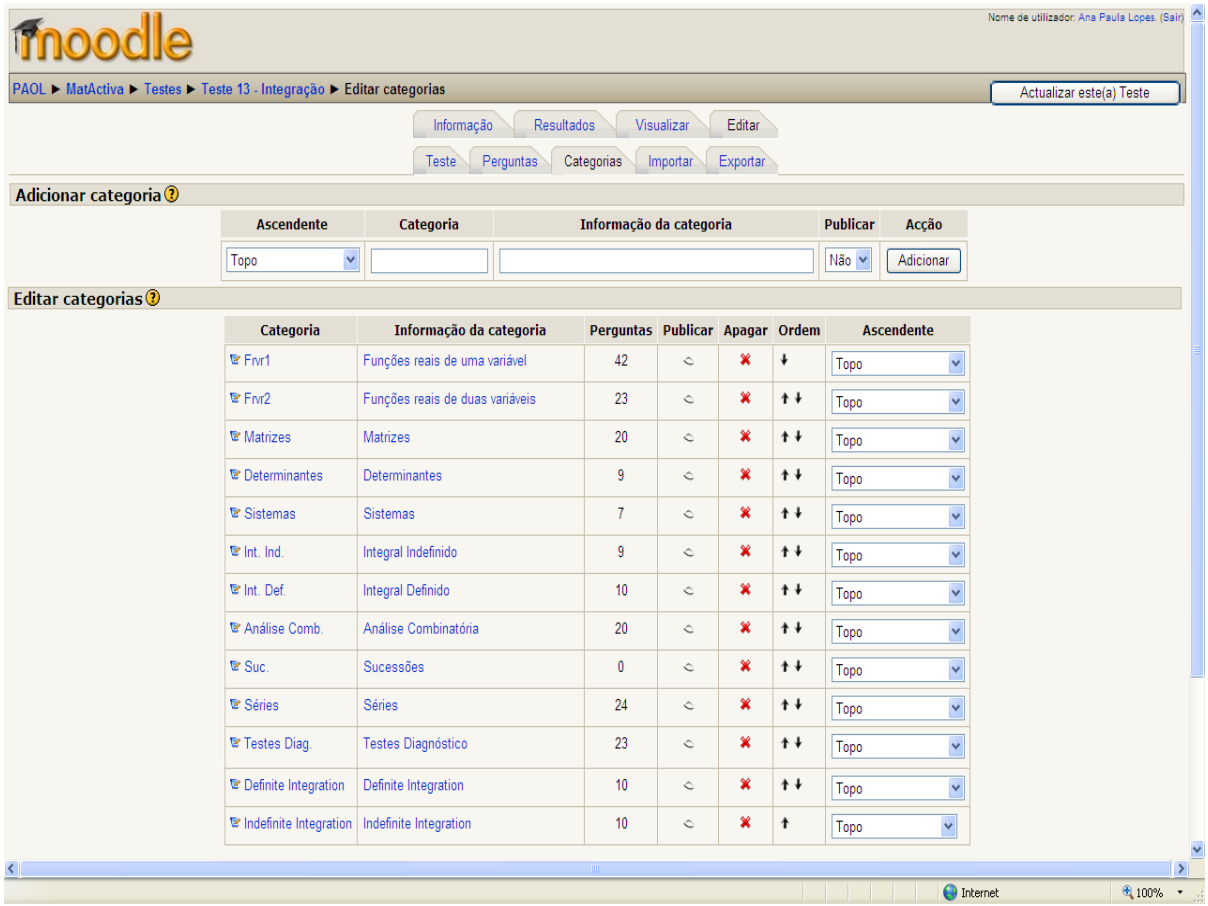

Fig.2. Categories

Then we can choose a category and start to write the questions, add more questions or editing.
In figure 3, we can see one example of this.
This is an example of category of Definite Integration that we construct for Erasmus students, which we have in this semester.

Fig.3. One Category – Definite Integration

The mathematics language requires a great effort from the submission of written text because the questions and answers are constructs in T_EX language.
There are some programs that facilitate the conversion of mathematical text to T_EX directly without the need to use the command of this language but these programs aren't so efficient.

In figure 4 is visible that we need a long time to generate the required language to write the multiple-choice answers using T_EX. In our multiple choice tests, we have four options for the answer but there is only one correct answer. We can also see in this figure, that we use the field "feedback for any incorrect answer" as a result students can have, for each wrong answer, the correction of that and discover where they failed.

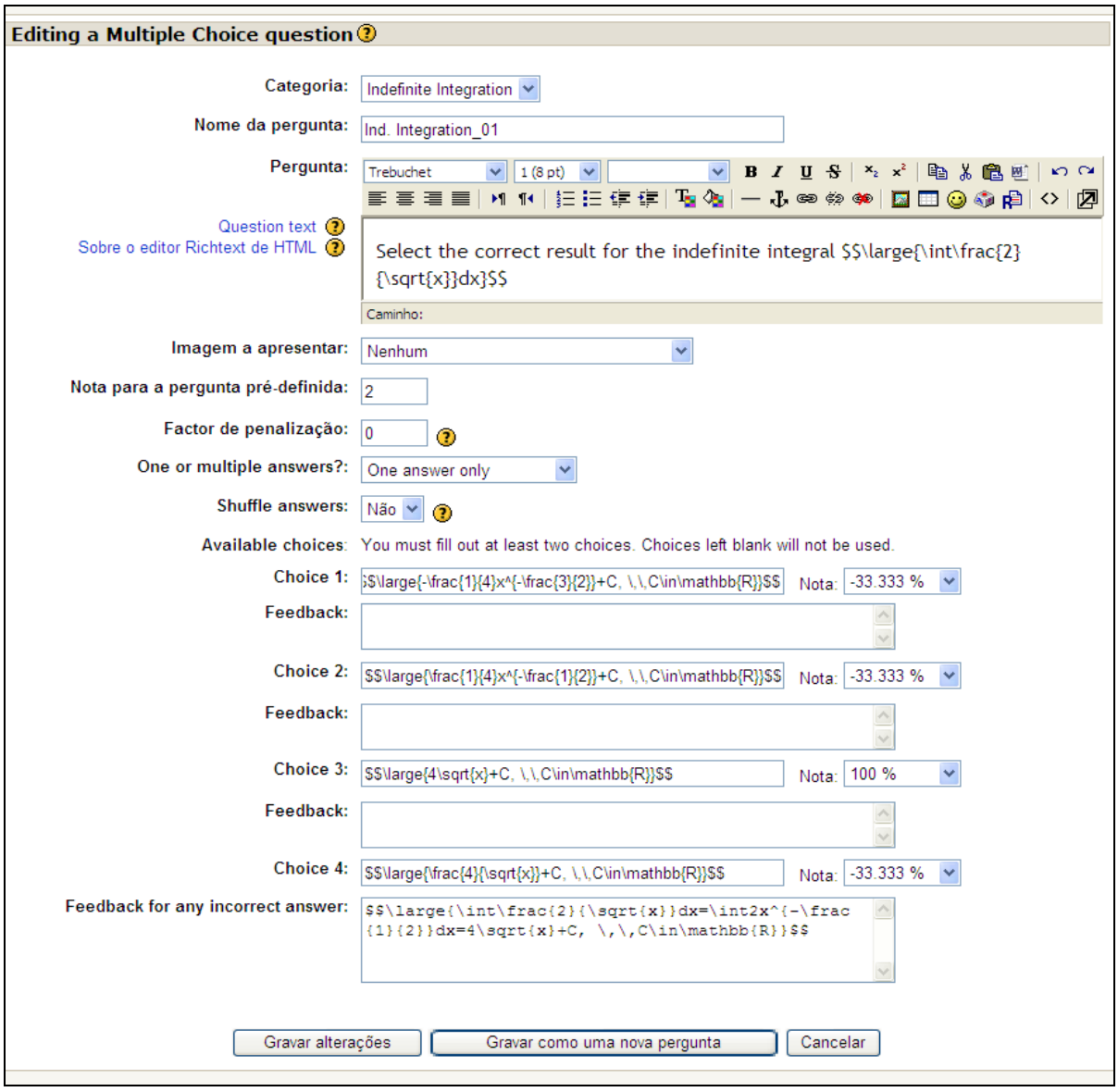

Fig. 4. Edition a question with T_EX

We can see in figure 5 some questions of a multiple choice test.

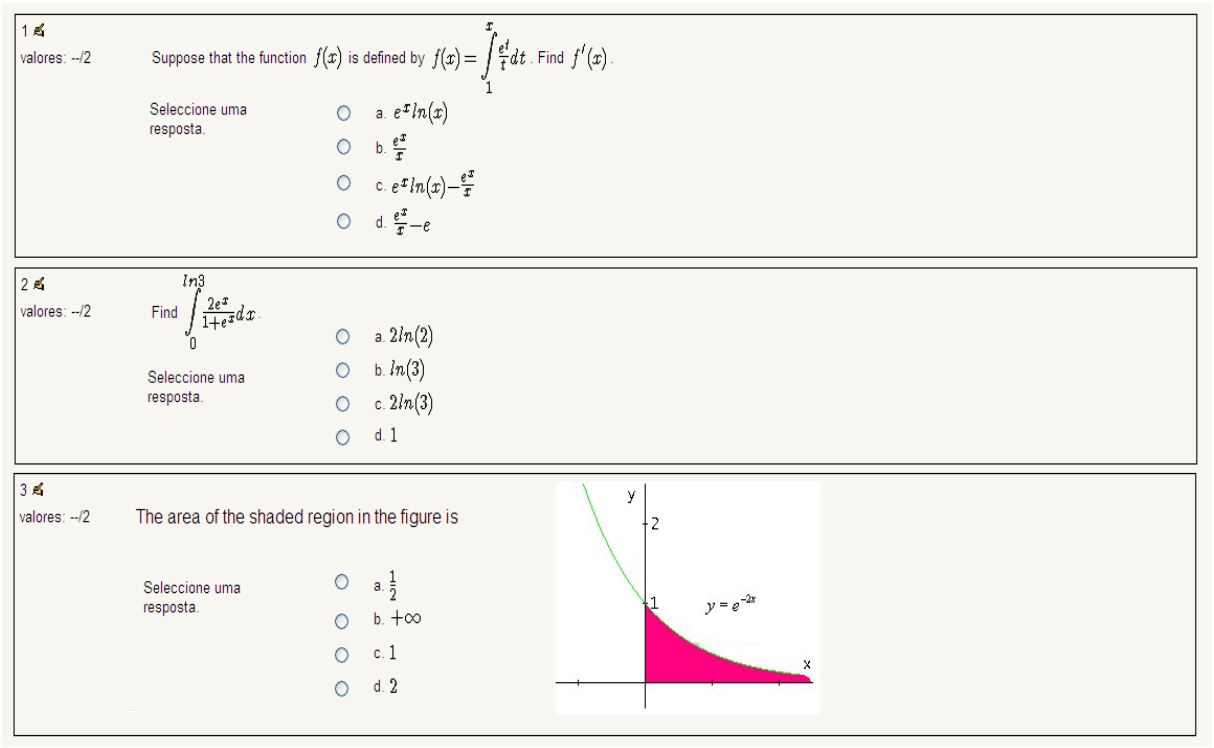

Fig.5. Example of three questions of a multiple choice test

5. RESULTS

The acception of the students has been excellent, exceeded our expectations. The students are very happy with this project, us we had opportunity to weird in the classes and to read the opinions that they let in the forums, they are always asking for more material.
The area used more often by the students is that of multiple-choice tests, perhaps because it is one way to prepare them to the exams of Mathematics, two subjects that they have in the first year in Accounting and Administration and in International Commerce, and a knowledge test. The number of students who access the page grows every day and it encourages us to continue with this project.
The only unfavourable point is the fact that this whole project was developed only by a small number of Mathematics teachers, and we want to be able to help all the courses that have subjects of Mathematics. This is a hard work for a few people with a few time to do it.

6. CONCLUSION AND FUTURE WORK

One of the great objectives of this project was to motivate students, encourage them to overcome their difficulties through a self-study giving them more confidence.
In this project the students were able to access the material to support of their study in the subject of mathematics, self-evaluation tests, links to topics of interest related to mathematics, links to pages containing concepts of mathematics related to the subject of mathematics and for materials of secondary education.
In future we intend to implement a system of continuous evaluation based on multiple-choice tests performed on the computer. Various works of evaluation can be implemented, automatically corrected and the results exported to Excel. This is very helpful when the number of students is very high.

We wish to develop the topic of "Mathematics 0", producing materials for all the students who didn't have maths in secondary school and can overcome this deficiency with that, which is provided in the page of the MatActiva. We also intent to provide contests and challenges to capture the attention of students and try that students participate in this project always in an active way.

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